REMARKS

Claim 2 was rejected under 35 U.S.C. §112, second paragraph, as being indefinite. It was said to be unclear how the system comprises a source of patient heart waveforms. This may be understood by referring to the upper right corner of Fig. 3. It appears that this application was filed only with the "empty box" drawings that applicants used in their PCT application. Enclosed is a new set of formal drawings, each labeled, "Replacement Sheet," which corresponds to the text-filled drawings of the priority provisional application 60/562,846. This set of drawings will provide clarity, not only for the Examiner, but for subsequent readers of the patent. It is respectfully requested that the Examiner approve entry of these replacement sheets to replace the formal drawings currently of record. Fig. 3 shows ECG electrodes and an ECG waveform processor 164, either one of which may serve as the "source of patient heart waveforms" called for by Claim 2. It is therefore respectfully submitted that Claim 2 is suitably clear.

Claims 1-9 and 14 were rejected under 35 U.S.C. §102(e) as being anticipated by commonly assigned US patent appl. pub. 2003/0195421 (Demers et al.), which is now US Pat. 6,755,788. Amended Claim 1 describes an ultrasonic diagnostic imaging system which acquires images of differently oriented image planes of a patient in rapid succession comprising a probe including a two dimensional array transducer; a beamformer, coupled to the array transducer, for scanning beams over a variety of different directions and inclinations with respect to the array transducer; a beamformer controller programmable to scan beams over differently oriented image planes in a sequence of image planes until acquisition of the image planes has been completed; an image processor coupled to the beamformer; a display coupled to the image processor; a plane orientation control, coupled to the beamformer controller, for adjustment of the orientations of a

plurality of image planes relative to selected anatomy; a storage device responsive to the plane orientation control and operative to store parameters of different image plane orientations selected by operation of the plane orientation control; and an acquisition control, coupled to the beamformer and responsive to the stored parameters, for initiation in a diagnostic exam of the acquisition of a sequence of image planes in the selected succession of different orientations with respect to the selected anatomy. An implementation of the present invention is useful when different image planes have to be imaged during a procedure in a short amount of time and the user is able to set up the image plane orientations before the procedure commences. The user can, prior to the procedure, move and steer a sequence of images to desired plane orientations with the plane orientation control. After the orientation of each image plane has been adjusted, the plane orientation is stored in a storage device. When the diagnostic exam is underway and the user needs to acquire the pre-steered image planes, an acquisition control is triggered to initiated acquisition of a sequence of images in the pre-set plane orientations. Since the probe includes a 2D array, the images can be quickly electronically steered to their desired orientations and acquired in succession without moving the probe. This capability is very useful during a contrast exam or a stress echo exam, where a succession of images in a succession of different image planes (AP4, AP2, AP3) need to be acquired, and doing so rapidly either prevents over-stressing the patient, infusing excessive contrast agent into the patient, or both. In essence, the succession of different plane orientations is pre-programmed and stored on the ultrasound system, then quickly triggered to replay the sequence and acquire the desired sequence of differently oriented images during the exam.

Demers et al. describe a predecessor to the present invention, which is a biplane imaging system. In biplane imaging a 2D array probe scans two differently oriented image planes and

then displays the images of the two planes side-by-side. It is generally necessary only to be able to manipulate the orientation of one of the planes and thus in the preferred embodiment one plane is stationary, extending orthogonally from the plane of the transducer array. The second plane is then steered with respect to the fixed plane and can be rotated or tilted with respect to the plane of the first image. The acquisition of images of the two planes is explained in paragraph [0028] of the application. One technique is to scan all of the first image, save the scanlines, then scan all of the second image and save the scanlines. Another technique mentioned is to interlace the scanning of the two images by acquiring a line of one and then a line of the other in alternating succession. Either way, a new display frame is not displayed until both image planes have been scanned and their display buffers updated. Since both images are displayed side-by-side on one display, a new frame of each image is acquired before the display frame can be fully updated. This means that if each image can be acquired in one- 30th of a second, a very respectable frame rate, the display frame rate is only 15 frames per second, the time needed to scan both images, which can cause blurring when imaging rapidly moving objects like the heart.

The biplane system of Demers et al. has no starting or stopping of its sequencing. Rather, it is continually scanning both image planes in alternating or interlaced succession. The continual scanning continues even as a plane is rotated or tilted; it never stops and cannot be triggered to start. It is not possible to adjust the plane orientations and store the adjustments on a storage device to be used later as with the present invention. There is no acquisition control which can be actuated or triggered during a diagnostic exam to initiate acquisition of a sequence of images in the previously stored succession of different plane orientations. This ability of the claimed invention means that a system of the present invention is

not constrained to side-by-side biplane display, but can always show only one image plane on the screen at a high frame rate and in full size rather than reduced side-by-side display. Such high frame rate, full size images are much preferred by clinicians for their diagnostic capability than smaller, slower frame rate images. The controlled initiation of the acquisition control means that acquisition can also be selectively triggered by a physiological event such as a particular phase of the heart cycle using an ECG trigger signal. This is not possible in Demers et al., where acquisition is free-running and continuous. For all of these reasons it is respectfully submitted that amended Claim 1 and its dependent claims are not anticipated by Demers et al.

Claims 10-13 and 15-20 were rejected under 35 U.S.C. §103(a) as being unpatentable over Demers et al. in view of US Pat. 5,947, 904 (Hossack et al.) Hossack et al. was cited for its showing of contrast imaging gated by an EKG signal generator 32. Hossack et al. are using a probe with two transducer arrays, a high power array 20 which is selectively triggered to disrupt contrast agent in a blood vessel, and a low power array 22 which is used to image the flow of contrast downstream from the point of disruption. As shown in Fig. 3 of Hossack et al., this enables the imaging array to image the periodic disruptions of the contrast agent as they flow by, enabling the clinician to gauge the speed and laminar quality of the blood flow in the vessel. But the imaging transducer 22 only images one plane which extends directly in front of it. The transducer cannot image multiple planes and the single plane cannot be changed in orientation. It always extends orthogonal to the array as Fig. 2 of Hossack et al. illustrates. There is no storage device to store different plane orientations because only one is possible. There is no ability to initiate acquisition of a sequence of images of different orientations during a diagnostic exam because only one plane can be repetitively and continuously imaged. For all of these reasons it is respectfully submitted that the

combination of Demers et al. and Hossack et al. cannot render Claim 1 or its dependent Claims 10-13 and 15-20 unpatentable.

In view of the foregoing amendment and remarks it is respectfully submitted that Claims 1-9 and 14 are not anticipated by Demers et al. and that Claims 10-13 and 15-20 are patentable over the combination of Demers et al. and Hossack et al. Accordingly it is respectfully requested that the rejection of Claims 1-9 and 14 under 35 U.S.C. §102(e) and of Claims 10-13 and 15-20 under 35 U.S.C. §103(a) be withdrawn.

In light of the foregoing amendment and remarks, it is respectfully submitted that this application is now in condition for allowance. Favorable reconsideration is respectfully requested.

Respectfully submitted,

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